

Breeding and moult cycles of the Yellow-bellied Greenbul *Chlorocichla flaviventris* in coastal Tanzania

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Little published information is available on the annual cycles of breeding and moult of the Yellow-bellied Greenbul *Chlorocichla flaviventris* (see Keith *et al.* 1992). As part of a study on the ecology of bulbuls (Pycnonotidae) in coastal Tanzania, breeding and moult of the Yellow-bellied Greenbul were examined. The aim of this paper is twofold, first to show the seasonality of the two physiological events, and second to make available the results for comparison with studies elsewhere of this or other related species in Africa.

Study area and methods

The data were collected from mist-netted birds during the period January 1989 to June 1990 and from June 1994 to May 1995 in coastal thickets and forests of Tanzania between 6°10'–8°23'S and 38°35'–39°20'E. The climatic features in the study area have been described in detail by Griffiths (1958). He noted that the area has a rainfall pattern comprising two wet seasons, 'long' rains in March and May and 'short' rains in October–December. In between the wet seasons, there is a short, relatively dry period in January and February and a long dry season in June and September. Recent information on the rainfall pattern in the study area has been provided by Mlingwa (1993).

For each bird, I recorded biometric data, moult and whether a brood patch was present, and finally released it after banding with a numbered aluminium ring of the East Africa Natural History Society.

Presence of a brood patch was considered to indicate breeding activity (Brooke 1985). For moult, I examined the remiges (primaries and secondaries), rectrices, and the head and body feathers. Only the moult of the primaries is considered here, for it spans the entire moulting period, and is therefore a reasonable index of the whole moult (Fogden 1972, Hanmer 1978).

Individual primary feather growth was scored on a scale from 0 (= old) to 5 (= new fully grown) (Ginn & Melville 1983). Since the Yellow-bellied Greenbul has ten primaries on each wing, the maximum score per wing is 50.

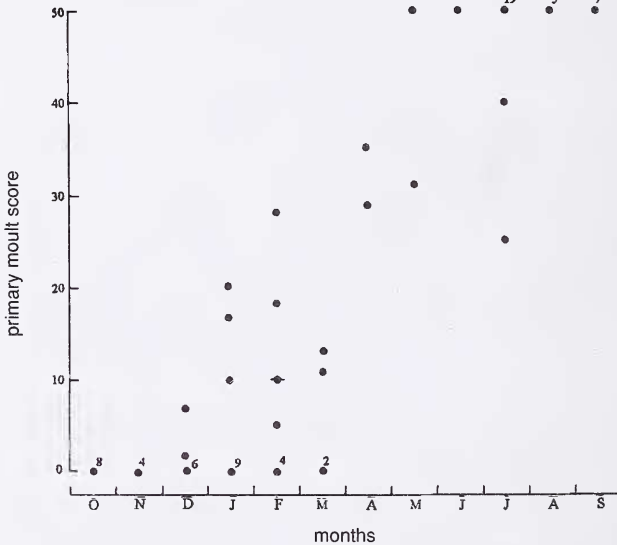
Moult was considered to be interrupted if, among the ten primaries, there were inner new fully-grown feathers and outer old ones (Ginn & Melville 1983).

Results

Birds with brood patches were caught during October to March, and primary moult was recorded from December to July (Table 1). The lengths of breeding and moulting seasons for the population were therefore six and eight months respectively. Figure 1 shows the progression of primary moult score in each month. Using the regression

Table 1. Incidence of brood patches and primary moult of adult *Chlorocichla flaviventris* in coastal Tanzania

Months	O	N	D	J	F	M	A	M	J	J	A	S
No. examined	8	4	8	12	8	4	2	2	1	21	5	7
% with brood patch	38	25	50	58	50	25	0	0	0	0	0	0
% moulting	0	0	25	25	50	50	100	50	0	10	0	0

Figure 1. Primary moult score in adult *Chlorocichla flaviventris*. Numbers indicate the sample size for each dot. Dots without a number represent one bird.

● refers to interrupted moult

method of estimating the duration of moult of individual birds, the equation (taking 28 December as day 1) is

$$date = 3.88 + 3.82 (\text{moult score}).$$

The estimated duration was 195 days.

There were marked individual variations in the onset of primary moult, the earliest being in December and the latest possibly in April for those birds which had not began feather replacement in March (see Fig. 1).

Replacement of primary feathers followed the pattern usual for passerine birds,

initiated from inside descendently (Ginn & Melville 1983). Moulting on the two wings was symmetrical, as found in other bulbuls (Hanmer 1978). Interrupted primary moult was recorded in only one individual in February (Fig. 1).

Discussion

Breeding and moult were seasonal, the onset of the former coinciding with the beginning of the 'short' rains in October and terminating at the start of the 'long' rains in March. This situation suggests that the Yellow-bellied Greenbul avoids breeding during heavy rains in April and May. Such a breeding cycle resembles that of the Zanzibar Sombre Greenbul *Andropadus importunus* and the Common Bulbul *Pycnonotus barbatus* in the same area (Mlingwa 1993).

In the population as a whole, primary moult was initiated at the end of the 'short' rains in December and completed most likely in September or October, for birds were still moulting in July (see Fig. 1). The moulting season also ends in October in the Common Bulbul in coastal Tanzania (Mlingwa 1993).

Within the population there was a four-month period of overlap of breeding and moulting seasons, between the end of the 'short' rains in December and the start of the 'long' rains in March. This period has been shown to be the most favourable part of the year in terms of food supply (Mlingwa 1997).

It is likely that adult birds which complete breeding earlier also start annual moult earlier, hence the intraspecific variation in the onset of primary feather replacement. Another, but not exclusive, possibility is that the sexes have differing commitments towards brooding, so that in males moult starts earlier than in females (see Snow 1976, Greig-Smith 1980, Zann 1985).

Compared with observations made in southern Africa (Hanmer 1978, Vernon 1978), *C. flaviventris* has protracted breeding and moulting seasons in coastal Tanzania. Here there seems to be a prolonged availability of abundant food such as ripe fleshy fruits (Mlingwa 1993, 1997), and this seems to sustain the two annual events for long periods.

Although a regression method is likely to have overestimated the duration of feather replacement (see Underhill & Zucchini 1988), the rate of moult was slow. Feather replacement was initiated towards the end of December and birds with completed moult were noted in May (Fig. 1), about a five-month period. A long duration of primary moult has been recorded in other bulbul species in coastal Tanzania (Mlingwa 1993, 1996) and elsewhere in Africa (e.g. Britton 1972, Hanmer 1978, Dowsett & Dowsett-Lemaire 1984, Mann 1985). Such a phenomenon has been described by Dowsett & Dowsett-Lemaire (1984) as energetically less stressful. In coastal Tanzania, prolonged moulting is perhaps much more important for birds replacing their primary feathers during the June-September dry season, which is a lean period in terms of food supply (Mlingwa 1997).

The near absence of interrupted moult in the Yellow-bellied Greenbul is also a feature of other bulbul species found in the study area (Mlingwa 1993, 1996).

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